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Original Article

Incidence of surgical site infections and associated risk factors in clean orthopaedic surgeries

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Abstract

Objectives: The study aimed to estimate the incidence of SSI in clean orthopaedic surgeries, while identifies the associated risk factors and prevalent infective microorganisms. **Methods**: This was a prospective, observational study conducted in patients who underwent orthopaedic surgeries during the period between October-2019 to March-2020. Adult patients admitted in the in-patient wards of Orthopedics and underwent (category 1) clean wound type of orthopaedic surgeries (elective or emergency) were included in the study. Patients' demographics details, clinical history, characteristics of disease, surgery-related variables, pre/ post management, hospital stay details and laboratory indexes were inquired and documented. We excluded other categories of surgical wounds (category 2, 3 and 4). **Results**: In this study, incidence of SSI in clean wound orthopaedic surgeries was 6.84 %. The male to female ratio was 1.8. In this study, SSI was associated significantly with age, comorbid condition, and pre-op hair removal technique. The most common infective organisms identified on culture were Klebsiella pneumonia and Methicillin-resistant Staphylococcus aureus. **Conclusion**: Incidence of SSI in clean orthopaedic surgeries was high. Proper identification and optimization of modifiable risk factors needs to be done prior to orthopaedic surgeries to reduce the risk of SSI.

Keywords: Clean wound, micro-organisms, Orthopaedic, Risk factors, Surgical site infection

Introduction

Despite major advances in infection prevention strategies, health care-associated infections (HAI) still remain a major public health problem globally[1,2]. Surgical site infections (SSIs) are infections of the incision, organ, or operative space that occur after surgery and are a common type of HAI[3].

Infections after orthopedic surgical procedures are devastating complications which have significant clinical and financial[3]. Studies have documented SSI in orthopaedic setting ranging from 0.3% to 25%[4-19], with incidence approximately 4 times higher in low- and middle-income countries than in high income countries[1].

SSI involves a complex relationship among several factors: microbial, patient, surgical, and environmental[20-23]. SSIs are often associated with a high burden on patients and hospitals in terms of morbidity, mortality, and additional costs[24].

In India, studies have shown SSI rates ranging between 4% and 70% in different types of orthopedic wound (clean/ contaminated/infected) surgeries with association of several independent risk factors[14-19]. However, there is a paucity of data on SSI especially in clean orthopaedic surgical procedures in India. Therefore, the study was aimed to evaluate the incidence of SSI in clean orthopaedic surgical procedures and explore its associated factors at a teaching hospital.

Material and Method

This was a prospective, observational study conducted in the department of Orthopedics from October-2019 to March-2020 at tertiary care teaching hospital in Navi-Mumbai (India). All procedures followed were in accordance with the ethical standards of the responsible committee on

The authors have no conflict of interest.

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	Characteristics	Value
Total patients (n)		307 (100%)
Age in years	Mean (± SD)	47.5± 14.4
Age group	< 60 years	254
	≥ 60 years	53
Gender	Male	198
	Female	109
Smoker	Yes	53
	No	254
Co-morbid condition (Diabetes)	Yes	71
	No	236
American Society of Anesthesiologists (ASA)score	1 or 2	293
	>2	14
Surgery	Elective	259
	Emergency	48
Orthopaedic surgery	ORIF with plating	97
	CRIF with K-wiring	99
	CRIF with IMIL nailing	49
	CRIF with PFN A2	26
	CRIF with long PFN	36

SD: Standard Deviation.

Table 1. The general characteristics of the participants.

human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. This study was approved by the Institutional Ethics Committee (IEC) (Approval reference no. DYP/IECBH/2019/68) of the Hospital. Informed consent was obtained from study participants.

The study included adult patients of either gender admitted in the in-patient ward of Orthopedics and underwent (category 1) clean orthopaedic surgical procedures. Exclusion criteria were patients with open reduction fracture, clean contaminated/contaminated/dirty wound surgery, pathological/compound fracture, fracture requiring external fixator, soft tissue surgery, presence of skin infection at the site of incision preoperatively and treated with antibiotic prophylaxis other than the standard hospital antibiotic practice.

For each patient, the related sociodemographic, comorbidities, surgery-related variables, pre/post management, hospital stay details and laboratory indexes were recorded. As a standard practice prophylactic, intravenous antibiotic combination of Cefoperazone (1000 mg) plus Sulbactam (500 mg) were given 1 hour prior to surgery.

Based on the inclusion criteria, patients were included after taking informed consent during the postoperative period. Patients were observed for post-operative wound infection in hospital for 30-day period. If discharged before 30 days, surveillance was made by reviewing in outpatient clinic during follow-up period. They were also contacted by telephonically for symptoms of wound infection (pain, swelling, redness, increased temperature), and, if a surgical site infection (SSI) was suspected, they were asked to return to hospital outpatient clinic for examination and to confirm the diagnosis. The diagnosis of surgical site infection was based on clinical observations and microbiology reports.

Statistical Package for the Social Sciences (IBM SPSS, Windows) software version 20 was used for statistical analysis. Descriptive analysis was done by using frequencies, percentages and means where appropriate. Chi-Square was used for categorical variables. A measure of association between SSI and risk factors were calculated with the Pearson chi-square test. P values <0.05 was considered statistically significant.

Results

Out of 307 patients, 198 (64.5 %) were male and 109 (35.5%) were female. The male to female ratio was 1.8. The mean age of the participants was 47.5±14.4 years. The general characteristics of the participants are summarized in Table 1.

Parameters		SSI	Non- SSI	P value
Age group	< 60 years	13	241	0.008
	≥ 60 years	8	45	
Gender	Male	15	183	0.491
	Female	6	103	
Smoker	Yes	6	47	0.155
	No	15	239	
Co-morbid condition (Diabetes)	Yes	9	62	0.026
	No	12	224	
American Society of Anesthesiologists (ASA)score	1 or 2	19	274	0.258
	>2	2	12	
Days hospitalized preoperatively	≤3 days	7	190	0.002
	>3 days	14	96	
Pre-operative hair removal technique	Shave	17	132	0.002
	Trim	4	154	
Length of hospital stay	≤15 days	9	137	.655
	>15 days	12	149	
Blood transfusion	Yes	5	41	0.240
	No	16	245	
Orthopaedic surgery	ORIF with plating	7	90	0.662
	CRIF with K-wiring	4	95	
	CRIF with IMIL nailing	4	45	
	CRIF with PFN A2	3	23	
	CRIF with long PFN	3	33	

SSI: Surgical site infection.

Table 2. Associated risk factors with SSI.

Incidence of SSI

In this study, twenty-one patients developed surgical site infections. The overall incidence of SSI in clean wound orthopaedic surgeries was 6.8%.

Risk factors associated with SSI

In this study, SSI was associated significantly ($p<0.05$) with age, comorbid condition, days hospitalized preoperatively and pre-op hair removal technique (Table 2). There was no statistically significant association between gender, smoker, type of surgery, Orthopaedic surgery, ASA grade, blood transfusion and length of stay ($p>0.05$).

Infective organisms identified

In this study, the most common infective organisms identified on culture were Klebsiella (n=8) pneumonia Methicillin-resistant Staphylococcus aureus (n=7), Pseudomonas aeuginosa (n=4) and Coagulase-negative staphylococci (n=2).

Discussion

The findings of this study documented a significant burden of SSI in clean wound type of orthopaedic surgeries. The incidence rate of SSI found in the present study was 6.84% which is higher than accepted standard (less than 1%).

Studies from developed and under developed countries have documented SSI in orthopaedic setting ranging from 0.3% to 25%. Whereas, Indian studies have shown SSI rates ranging between 4% and 70%. However, for clean orthopedic surgical procedures, previous studies have documented SSI rates ranging between 1% and 18%.

The incidence rate of SSI (6.84%) in clean orthopedic surgical procedures in this study was lower than previous studies conducted by Ikeanyi et al (9.9%)[7], Maksimović et al (13.5%)[10], Jain et al (18.57%)[18], Jagiasi et al (12.27%)[19] and Ngim et al (9.38%)[12], but the incidence rate was higher than studies conducted by Mardanpour et al (2.3%)[8] and Ercole et al (1.4%)[5]. The variation in incidence rate of SSI in literature studies may be related to inclusion criteria, type of surgical wound, infection control policy and factors that vary among regions that may have an impact on the occurrence of SSI.

There are several known risk factors that play a role in the development of SSIs in orthopedic surgery[21-23]. The independent risk factors for development of SSI identified in the study were age, comorbid condition (Diabetes), days hospitalized preoperatively and pre-operative hair removal technique.

Studies have associated increasing age as risk for SSI[4,5,8]. In this study, SSI was more common in above 60 years of age which was similar to Amaradeep et al[14], Kimmatkar et al[16], and Jain et al[18] studies. Increasing age may be associated due to geriatric related factors such as low immunity, metabolic changes, multiple co-morbid conditions and poor wound healing rates.

Several comorbid conditions including diabetes have been associated as independent risk factor for the development of SSI[22]. Delayed wound healing and neutrophil dysfunction may be the cause of increasing SSI among diabetics[22]. In this study, we found that SSI was significantly associated in patients having comorbid condition (diabetes), which was in line with previous studies[9,10,14,16].

Study conducted by Maksimović et al, have documented that preoperatively shaving with razor for hair removal was significantly associated with SSI[10]. This study also confirms the fact that shaving can increase the risk for SSI, as shaving causes micro abrasions of the skin leading to risk of infections. Even CDC guidelines on prevention of SSI have placed preference for preoperatively clipping of hair[25].

With regard to clean orthopedic surgeries, Ikeanyi et al reported prolonged duration of preoperative hospital stay, increasing age greater than 60 years use of implants and drains as independent risk factors for SSIs[7]. In our study, we also documented that increased pre-operative hospitalization was significantly associated with SSI. The reason could be that increased pre-operative stay exposes/risk the individual to skin colonization of bacteria for hospital acquired infections. However, study conducted by Ngim et al did not find a statistically significant relationship between type of prophylactic antibiotic, the time of administration used, rank of the operating surgeon, human immunodeficiency virus status and co-morbid conditions such as diabetes mellitus with the incidence of SSIs[12].

In this study, we have found that the most common infective organisms responsible for SSI were Klebsiella pneumonia and Methicillin-resistant Staphylococcus aureus. Studies have most commonly reported Staphylococcus aureus as the cause of SSI[10,16-19].

Identification of causative organism has important implications antimicrobial management (prophylaxis and the treatment) of SSI as well for development of antimicrobial policy in orthopaedic surgery.

Overall, the increasing rates of SSIs in orthopedic surgeries emphasize the need for implementing strategies to minimize the chance of SSIs. Also, identification and understanding the risk factors for SSIs and their interplay is critical to the formulation of infection prevention strategies.

This study had some limitations. Study duration was 6 months and thus may not have account for seasonal variations. Data on some known risk factors were not collected. In addition, post discharge follow up for SSI was suspected through information provided by the patient, may have led to under-estimations.

Conclusion

The incidence rate of SSI following clean orthopaedic surgical procedures was high and standard infection control protocols and strategies are needed to control. Proper identification and optimization of modifiable risk factors needs to be done prior to orthopaedic surgeries to reduce the risk of SSI.

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